U. S. DEPARTMENT OF AGRICULTURE

FARMERS' BULLETIN No. 1479

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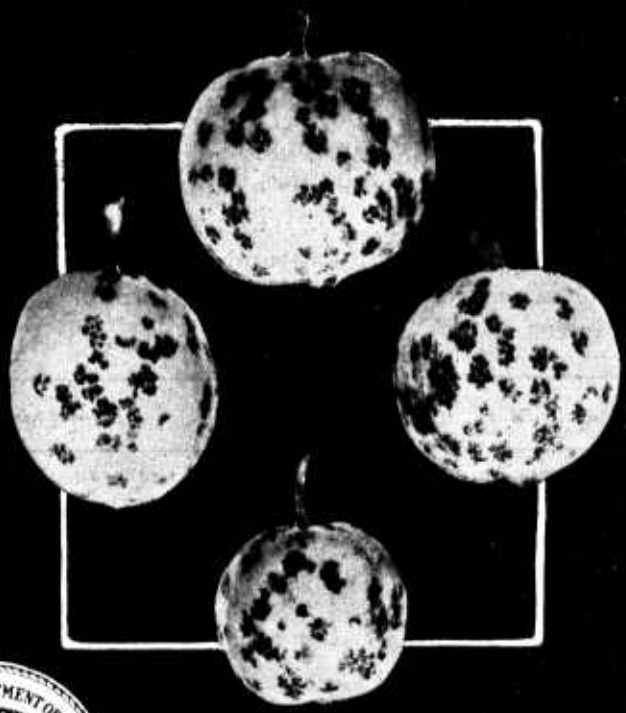
APPLE BLOTCH



APPLE BLOTCH is a destructive disease in most apple-growing sections of the middle-western and southern United States. Fruit, twigs, and leaves are affected, but the chief injury is to the fruit.

This bulletin describes the disease and recommends means for controlling it.

The relative susceptibility of apple varieties to the disease is shown.

Directions for spraying and for the making of Bordeaux mixture and dilute lime-sulphur solution are given.

Washington, D. C. Issued April, 1926

APPLE BLOTCH

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ECONOMIC IMPORTANCE OF APPLE BLOTCH

IN the southern and middle-western orchards of the United States blotch [1] is one of the most destructive apple diseases. It attacks the fruit, foliage, and twigs, including the fruit spurs, but it is the injury to the fruit which is the chief source of financial loss to the grower. The entire crop may be rendered worthless unless steps are taken to prevent attacks of the disease. In some sections of the Middle West such losses are not at all uncommon, and losses of from 50 to 75 per cent of the crop are frequent in unsprayed orchards. In uncared-for orchards or in orchards in which the disease has not been held under control, many twigs and fruit spurs may be killed. Trees of susceptible varieties which are not systematically sprayed are often killed by repeated attacks on twigs and leaves. Considerable damage to nursery stock is often caused by blotch.

DISTRIBUTION

Blotch occurs in the eastern and middle-western apple-growing sections from Pennsylvania, Ohio, Indiana, Iowa, and Nebraska southward. It is most serious and widely prevalent in Kansas, Missouri, Arkansas, and Tennessee. It is also a serious disease in fruit-growing sections bordering on or near the Ohio River. Further east it is only locally severe, but has become more prevalent in recent years. In those sections now free from the disease where fungicides such as lime-sulphur solution or Bordeaux mixture are regularly applied to apple trees during the late spring and summer, blotch should not become a very destructive disease. It is carried into new sections through the medium of diseased nursery stock.

[1] Caused by the fungus *Phyllosticta solitaria* E. and E.

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DESCRIPTION

The name "blotch" was given to the disease because it describes the characteristic spots appearing upon the fruit. These spots first appear in June as small, dark, somewhat raised or blisterlike areas, which slowly enlarge (figs. 1 and 2). By midsummer they are one-fourth to one-half inch or more in diameter, usually with fringed margins. A characteristic spot at this time is slightly raised, dark colored, and with margins so deeply cut in and so irregular as to give it its commonly noted fringed or stellate appearance (fig. 3). A later phase is the running together of several spots and a change in color to a deep brown or black, sometimes with complete elimination of the fringed margins (fig. 4). A cracking of the fruit, usually in three directions from a central point, is very common (figs. 3 and 4). The blotches vary somewhat with different apple varieties. On the fruit of Maiden Blush, for example, the young spots are usually much raised, or blisterlike, and may be light colored. On the fruit of Ben Davis, the spots at picking time are often smooth-margined depressions of dark-brown, hard, dry tissues. On yellow apples at this time the spots are often bordered with red.

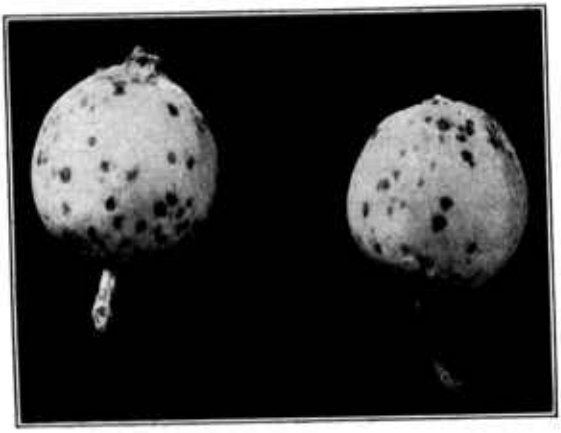

FIG. 1.—Early stages of blotch on very young apples

On the leaves the disease manifests itself as small, nearly white spots on the blades (fig. 5) and as dark, sunken, oval areas on the midribs and petioles (leaf stems). Blotch is not usually a serious foliage disease, but may become so under extremely favorable conditions.

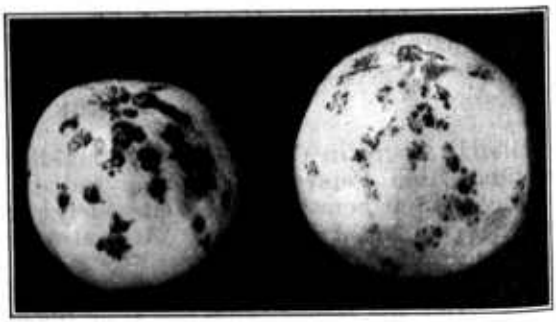

FIG. 2.—Another type of blotch on young apples

On the current year's growth of twigs, water sprouts, and fruit spurs blotch first appears in late summer as raised black blisterlike spots (fig. 6). Later the spots may become slightly sunken, but usually they continue to be somewhat above or level with the surface. As the twig, water sprout, or spur matures, the affected area or canker becomes lighter in color and finally in its second year as-

sumes a light-tan color in the older or central portion with a dark border denoting the extent of the second year's growth (fig. 7). Beginning with the third year the canker appears as an irregularly roughened area, because of a gradual sloughing off of the dead parts by growth from beneath them (fig. 8).

LIFE HISTORY OF THE FUNGUS

The fungus causing blotch lives through the winter in the cankers which it has developed on twigs, water sprouts, and fruit spurs. In

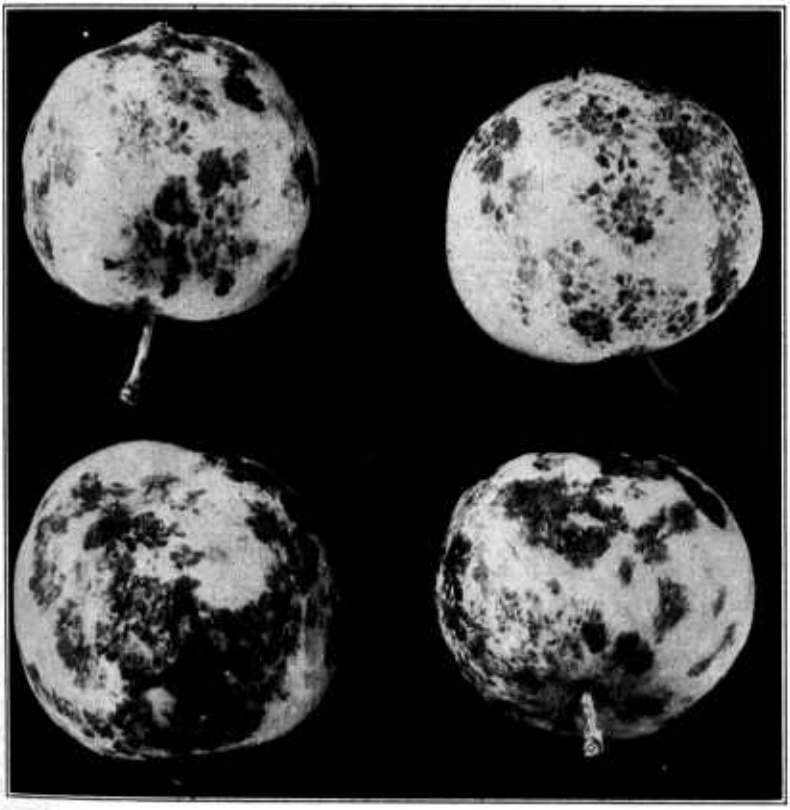

FIG. 3.—Typical blotch spots in midseason. Note the cracks

the spring spores from these cankers infect the new growth and especially the young fruit, the period of heaviest infection being from about three to nine weeks after the petals have fallen. The newly infected parts soon begin producing spores and so may spread the disease farther. After midseason the growing fruit becomes resistant so that few new infections occur. Only the new growths of leaves, twigs, and especially water sprouts are susceptible after this time. The younger cankers are the ones which carry the disease from one season to another. In those over 3 years of age the fungus is usually dead. The fungus rarely, if ever, lives over winter in the old leaves and fruit.

RELATIVE SUSCEPTIBILITY OF APPLE VARIETIES

Many varieties of the apple are extremely susceptible, but there are a number of commercial varieties which are very resistant. The resistant varieties are more liable to develop blotch if planted near susceptible ones because of the proximity of infection sources. The relative susceptibility of apple varieties, as shown in Table 1, will vary somewhat in different sections. In some sections, for example, Ben Davis would be considered as belonging to the moderately susceptible rather than the very susceptible group. In general, however, the arrangement in the table will be found correct.

TABLE 1.—*Relative susceptibility to blotch of leading apple varieties*

Very susceptible	Moderately susceptible	Resistant
Arkansas Black.	Arkansas (*Mammoth Black Twig*).	Delicious.
Ben Davis.	Benoni.	Grimes Golden.
Domine.	Collins.	Jonathan.
Fameuse.	Ingram.	Stayman Winesap.
Gano.	Kinnard.	Winesap.
Huntsman.	Mann.	York Imperial.
Lawver	Northern Spy.	
Limbertwig.	Oliver Red.	
McIntosh.	Paragon.	
Maiden Blush.	Ralls.	
Missouri Pippin.	Red Astrachan.	
Northwestern Greening.	Rhode Island Greening.	
Oldenburg.	Rome Beauty.	
Shockley.	Wealthy.	
Smith Cider.	Winter Banana.	
Stark.	Yellow Bellflower.	
Tolman Sweet.	Yellow Newtown.	
Wagener.	Yellow Transparent.	
Willowtwig.		

PREVENTIVE MEASURES

REMOVAL OF INFECTION SOURCES

Generally it is impracticable to remove the tiny cankers which carry the disease from season to season. In newly planted or very young orchards the removal of blotch cankers from the larger branches by cutting out the infected bark with a sharp knife and the pruning out of the smaller blotched branches or twigs are sometimes practicable as means for preventing the disease from gaining a firm foothold and becoming difficult to control when the trees begin to bear fruit. The Purdue Agricultural Experiment Station has successfully employed this method in southern Indiana. Pruning older trees is useful in reducing the number of cankers, but it is even more useful in opening up the tree so that it can be more thoroughly sprayed.

SPRAYING

Fortunately, as first shown by the United States Department of Agriculture in 1907, blotch can be readily controlled by three or four thorough applications of spray, preferably Bordeaux mixture. Furthermore, the spray by preventing many new twig infections reduces the number of overwintering infection sources and helps to control the disease in the year following.

It is difficult and often impossible to spray thoroughly thick bushy trees which need pruning, since the spray must strike and cover the part to be protected. With most sprays there is some risk of injury to the plant whose protection is desired. This risk is minimized by the choice of proper sprays, by using adequate apparatus, and especially by care on the part of the operator. It should be remembered that a spray in order to cover evenly and completely must be applied as a fine mist; otherwise it will collect into large drops. When spray is applied as a fine mist, too heavy applications are easily avoided and the risk of injury is greatly

FIG. 4.—Blotch on mature winter apples. The cracks were caused by the disease

lessened. Overspraying with coarse streams under high pressure is an especially bad practice. Such spraying may do great injury to fruit and foliage, particularly if practiced in the applications in spring, when these parts are young and tender. Applications of Bordeaux mixture for the control of blotch, especially the first one, should therefore be made with great care. Those who use spray guns should take particular pains to avoid overspraying.

Special applications of spray for the control of blotch should be made at intervals of about three weeks, beginning two weeks after the petals have fallen. Three of these applications are usually sufficient, but in very wet seasons another should be added and the in-

tervals shortened to about two weeks. Of the special applications the first two should be made with Bordeaux mixture, containing 3

FIG. 5.—Blotch on apple leaves

pounds of bluestone (copper sulphate) and 4 pounds of quicklime (or 6 pounds of hydrated lime) in each 50 gallons of water.

In later applications an additional pound of bluestone may be used, but in the earlier ones risk of serious injury is reduced by using only 3 pounds. Where blotch is only a minor disease, lime-sulphur solution (33° Baumé) diluted at the rate of 1½ gallons to 50 gallons of water may be used in place of Bordeaux mixture, to lessen the risk of spray injury. A previous loss of more than 10 per cent of the fruit on account of blotch calls for Bordeaux mixture rather than lime-sulphur solution. Arsenate of lead for the control of insect pests[2] should be added to the spray in the first and third applications and is also desirable in the second and fourth. The second and subsequent applications are also useful in the control of bitter-rot.[3]

For the control of scab,[4] blotch, leaf-spot,[5] and minor diseases, such as sooty blotch (cloud)[6] and Brooks fruit-spot,[7] the following general spray schedule should be followed with the modifications suggested above.

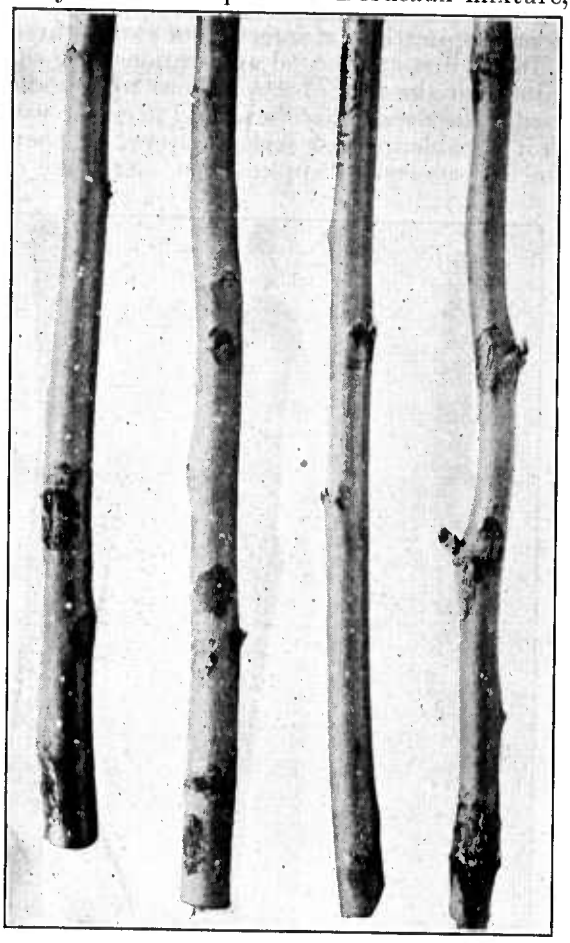

Fig. 6.—Young blotch cankers on apple water sprouts of the current year's growth

First application (dilute lime-sulphur solution) directly after the blossom cluster buds have opened.

Second application (dilute lime-sulphur solution) directly after the petals have fallen.

Third application (Bordeaux mixture) two weeks after the petals have fallen. This is the first special blotch application.

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[2] For directions for the control of insect pests of the apple, see U. S. Department of Agriculture Farmers' Bulletin No. 1270, entitled "The More Important Apple Insects."

[3] Caused by the fungus *Glomerella cingulata* (Stoneman) Spaulding and Von Schrenk. For the control of this disease, see U. S. Department of Agriculture Farmers' Bulletin No. 938, entitled "Apple Bitter-Rot and its Control."

[4] Caused by the fungus *Venturia inaequalis* (Cke.) Winter. For more specific directions on the control of scab, see U. S. Department of Agriculture Farmers' Bulletin 1478, entitled "Apple Scab."

[5] Caused by the fungus *Physalospora malorum* (Peck) S. S. and W.

[6] Caused by the fungus *Glocodes pomigena* (Schw.) Colby.

[7] Caused by the fungus *Phoma pomi* Passer.

Fourth application (Bordeaux mixture) two to three weeks later.
Fifth application (Bordeaux mixture) two to three weeks later.
Sixth application (Bordeaux mixture) two to three weeks later.

If the three-week interval has been followed in the fourth and fifth applications, the sixth application is unnecessary. If bitter-rot is to be controlled, the sixth application and two to three additional applications at intervals of two to three weeks should be made.

In the first and second applications lime-sulphur solution (33° B.) diluted at the rate of 1½ gallons to 50 gallons of water should be used. *Bordeaux mixture should never be used in these applications*, as it is liable to cause serious injury. It should be used in the third and all subsequent applications. Arsenate of lead, 1 pound of the

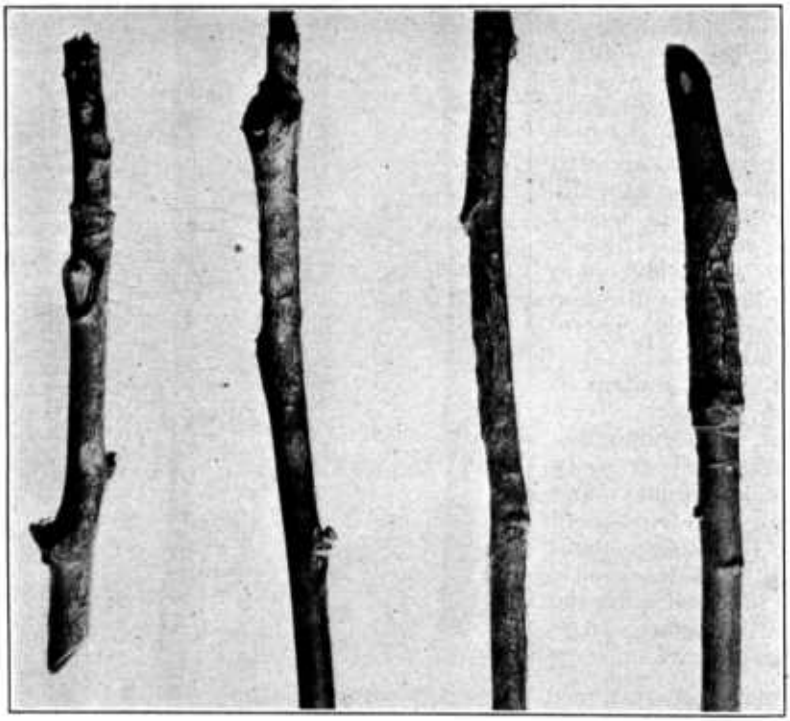

FIG. 7.—Blotch cankers during the second year of their development on apple twigs

powder or 2 pounds of the paste to each 50 gallons, may be added in all applications for the control of insect pests. None of the dusts so far developed has given good results in the control of blotch.

BORDEAUX MIXTURE

Bordeaux mixture for use on apples usually contains 4 pounds of bluestone (copper sulphate) and 4 pounds of quicklime (stone lime) to each 50 gallons of water. In the first two special applications for blotch control the quantity of bluestone should be reduced to 3 pounds. If the lime is of poor quality and does not slake readily 5 or 6 pounds should be used in all applications of Bordeaux mixture.

The directions here given are for quicklime. If hydrated lime is used the quantity should be increased by at least one-third. As hydrated lime is already slaked, it is ready for the required quantity of water to be added to it, as set forth in these directions.

To make a single barrel (50 gallons) of Bordeaux mixture, dissolve the bluestone in 25 gallons of the water, and in a separate barrel slake the lime and dilute it to 25 gallons. Then pour the contents of the two barrels simultaneously through a strainer into the spray tank. If large quantities are to be used a stock solution of the bluestone and a stock milk of lime should be prepared, in order to save time.

A stock solution of bluestone may be made by dissolving it at the rate of 1 pound to each gallon of water. Fill a 50-gallon barrel two-thirds or three-fourths full of water and place a sack (or a box with perforations in the bottom and sides) containing 50 pounds of bluestone in the upper part of the barrel, suspending it by a string or a copper wire. In from 12 to 24 hours the bluestone will have entirely dissolved, when the sack or box should be removed and enough water added to fill the barrel. If hot water is used the bluestone will dissolve in a few minutes. After stirring, the solution is ready for use.

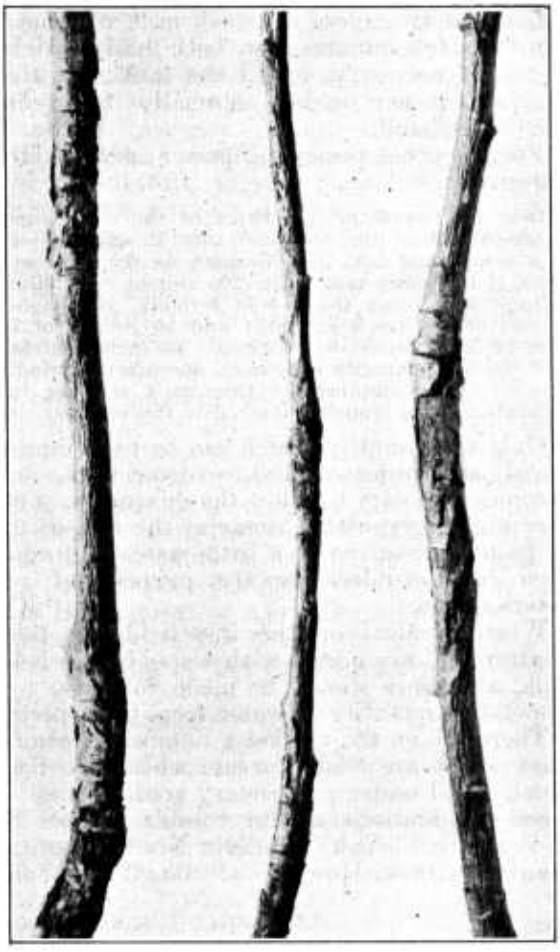

FIG. 8.—Old blotch cankers on apple twigs

A stock milk of lime may be prepared by slaking 50 pounds of stone lime in a barrel or other vessel and finally adding water to make 50 gallons. In slaking the lime sufficient water should be used to prevent burning but not enough to "drown" it. The water should be added a little at a time and the mixture stirred to the bottom until slaking is nearly completed. Sufficient water should then be added to leave a paste when slaking is finished. Water to make the 50 gallons may then be added.

Bordeaux mixture is easily made if a power sprayer with a good agitator is at hand. Fill the tank with water until there is room only for the required quantities of the stock fluids. Then, starting the engine (and accordingly the agitator), put in the stock solution of bluestone and slowly add the milk of lime. For example, if the tank holds 200 gallons, fill with water to about the 160-gallon mark and then, starting the engine, slowly add the 16 gallons of stock bluestone solution if the 4–4–50 formula is to be followed and afterwards the 16 gallons of stock milk of lime. Allow the engine to run for a few minutes after both fluids have been added. Add more water, if necessary, to fill the tank. By this method an elevated platform is not needed, especially if an efficient mechanical tank filler is at hand.

For those not possessing power sprayers, the following directions are given:

Take the necessary quantities of the stock copper-sulphate solution and the stock milk of lime and place them in separate elevated dilution tanks, each of which should hold half as much as the total capacity of the spray tank. Thus, if the spray tank holds 200 gallons each dilution tank should hold 100 gallons, and, using the 4–4–50 formula, 16 pounds of copper sulphate (16 gallons of the stock solution) and 16 pounds of lime (16 gallons of stock milk of lime) would be required. To each dilution tank add water (nearly half the total quantity of spray), and after stirring allow the diluted ingredients to run simultaneously through a strainer into the spray tank from separate hose or troughs attached to faucets near the bottom of each tank.

Only the quantity which can be used immediately should be prepared, as Bordeaux mixture deteriorates on standing. Where it becomes necessary to allow the mixture to stand for several hours or over night, granulated sugar at the rate of 2 teaspoonfuls for each 50 gallons dissolved in a little water and added to the mixture has been recommended for the purpose of retarding the rate of deterioration.

When arsenicals or other insecticides are to be used with Bordeaux mixture and are mixed with water before being added to the spray tank, allowance should be made for these by leaving out the corresponding quantity of water from that specified.

There are on the market a number of commercial Bordeaux mixtures which are ready for use when mixed with water. These are usually sold under proprietary trade names. Growers interested in these preparations should consult United States Department of Agriculture Farmers' Bulletin No. 994, entitled "Commercial Bordeaux Mixtures: How to Calculate Their Values."

LIME-SULPHUR SOLUTION

Concentrated lime-sulphur (32° to 34° B.) made up and ready for dilution may be obtained from dealers in spray supplies. For use on apple trees during the growing season it should be diluted at the rate of 1½ gallons to 50 gallons of water. A lime-sulphur preparation in dry form may be obtained, but care should be taken to see that it is such a product and not some other preparation. According to the reports of analyses and claims of manufacturers most dry lime-sulphurs contain about 70 per cent calcium polysulphide. A preparation containing this percentage of calcium polysulphide should be used at the rate of 6 to 6.5 pounds for each 50 gallons

of water to make a solution approximately equal to the concentrated solution diluted at the rate of 1½ gallons to 50 gallons of water. Manufacturers of the dry product have usually recommended too weak a solution for the best results. For immediate use a dilute solution suitable for the apple during the growing season can be prepared according to the following formula:

Stone lime (quicklime)	2 pounds
Sulphur, commercial flour, or flowers	4 pounds
Water to make	50 gallons

An iron kettle or a similar vessel raised on bricks or stones so that a fire can be built under it should be provided. After starting a fire under the vessel containing a small quantity of water, the lime should be dumped in and, if necessary, enough additional water poured in to slake it. The sulphur should be screened to break up the lumps and added to the mixture, together with enough water from time to time to make a thin mixture that can be easily stirred. Boiling with occasional stirring should continue for about 45 minutes, which approximates the time necessary for the lime and sulphur to unite and go into solution. More water should then be added, to cool the solution so that it can be handled. It is then ready to be passed through a strainer into the spray tank, which should contain enough water to make 50 gallons. The formula, of course, can be used to make up proportionately larger or smaller quantities if desired. High-grade lime, practically free from calcium carbonate (air-slaked lime) and magnesium compounds, which form an insoluble sludge in the final product, is necessary. If stone lime is not obtainable hydrated lime may be used at the rate of one-third more. When hydrated lime is used the heat of slaking will, of course, be lacking, but the procedure is the same. Commercial growers requiring large quantities of lime-sulphur solution are referred to United States Department of Agriculture Farmers' Bulletin No. 1285, entitled "Lime-Sulphur Concentrate," which furnishes information on the making of the concentrated solution on a large scale.

SPREADERS

To each 50 gallons of Bordeaux mixture one-half pound of casein-lime, or 2 pounds of rosin-fishoil soap, or one-half gallon of lubricating-oil emulsion (stock) may be added for the purpose of spreading the spray more evenly over the surfaces of fruit, foliage, and twigs. When stabilized by the addition of 6 ounces of carpenters' ground glue to each gallon of the stock emulsion, the lubricating-oil emulsions are miscible with lime-sulphur solution, but this mixture is apt to cause serious injury to the foliage. Casein-lime is a good spreader for lime-sulphur solution.

Spreaders are not essential to success if the spraying is carefully done. In the writers' experiments the benefits derived from their use have been for the most part slight or lacking. They have been of some benefit when used in summer applications for the control of bitter-rot. When, as in years especially favorable to the development of diseases, maximum efficiency is required of a spray, spreaders may prove their usefulness.

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